Product Specification

Model Name: E120A390QSR

Description： 1.19” (390X390) AMOLED Oncell

Doc. Version： 01

Customer： Common Customers

■Approved for Preliminary Specification

□Approved for Final Specification

□Approved for Final Specification & Sample

Prepared	Checked	Approved

Customer’s Approval

Version History			
Version. No	Date	Contents	Remark
01	2020-07-20	Preliminary Specification	

Contents

1 Scope

This Specification defines AMOLED manufactured by EverDisplay Optronics(Shanghai) Limited, from here on refer as EDO. In the case of any unspecified item, it may require both EDO and the party designs this module into its product to work out a solution.

2 Features

2.1 Product Applications

Smart Watch(On-cell)

2.2 Product Features

1) Display color：16.7M (RGB x 8bits)
2) Display format：1.19”(390RGBx390)
3) Pixel arrangement：Real RGB arrangement
4) Interface：MIPI/SPI/QSPI
5) Driver IC: RM69091

3 Maximum Rating

Parameter	Symbol	Spec			Unit	Note
		Min.	Typ.	Max.		
Analog/boost power voltage	VCI	-0.3	-	5.5	V	-
I/O voltage	VDDIO	-0.3	-	5.5	V	-
Operating temperature	Top	-20	-	60	℃	-
Storage temperature	Tstg	-30	-	70	℃	-

4 Mechanical Specifications

Item	Specification	unit
Dimension outline	33.99(V) x 33.62(W) x 0.7(T)	mm
LTPS Glass outline	33.99(V) x 33.62(W)	mm
Encapsulation Glass outline	32.63(V) x 33.62(W)	mm
Number of dots	390(W) x RGB x 390(H)	dots
Active area	ϕ30.42	mm
Diagonal size	1.19	inch
Pixel pitch	78 x 78	μm
Glass thickness	0.3 / 0.2	mm

（LTPS/encapsulation glass）		
Weight	TBD	g

5 Electrical Specifications

5.1 Electrical Characteristics

5.1.1 Power Characteristic：

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
AMOLED Power positive	ELVDD	4.55	4.6	4.65	V	-
AMOLED power Negative	ELVSS	-2.45	-2.4	-2.35	V	Ref
Digital Power supply	VDDIO	1.65	1.8	1.95	V	Ref
Analog Power supply	VCI	2.7	2.8	2.9	V	Ref

1) Normal Mode

Power Supply: IOVCC=1.8V VCI=2.8V

Frame Frequency: F_{frame} =60HZ @ 25degC, Brightness 350 nits, Command Mode,

Display Condition	Symbol	Min.	Typ.	Max.	Unit	Remark
100% Pixel On 350nits	IELVDD /ELVSS	-	17.5	21.5	mA	Ref
	IVCI	-	6.0	7.2	mA	Ref
	IVDDIO	-	2.4	2.8	mA	Ref

2) Idle Mode

Power Supply: IOVCC=1.8V VCI=2.8V

Frame Frequency: F_{frame} =15HZ @ 25degC, Brightness:30nits, OPR:10%,Command Mode

Display Condition	Symbol	Min.	Typ.	Max.	Unit	Remark
10% Pixel On 30 nits	IELVDD /ELVSS	-	-	-	mA	Supplied by Driver IC
	IVCI	-	3	3.6	mA	Ref
	IVDDIO	-	1.2	1.5	mA	Ref

3) Deep Standby Mode

Display Condition	Symbol	Min.	Typ.	Max.	Unit	Remark
Deep Standby	IVCI	-	-	15	uA	-
	IVDDIO	-	-	4	uA	-
	Power Consumption	-	-	<50	uW	Ref

5.1.2 Power supply circuit application (This is for reference only)：

AAT1551/RT4730

5.2 I/O Connection and Block Diagrams

5.2.1 Main FPC Bonding PAD Define

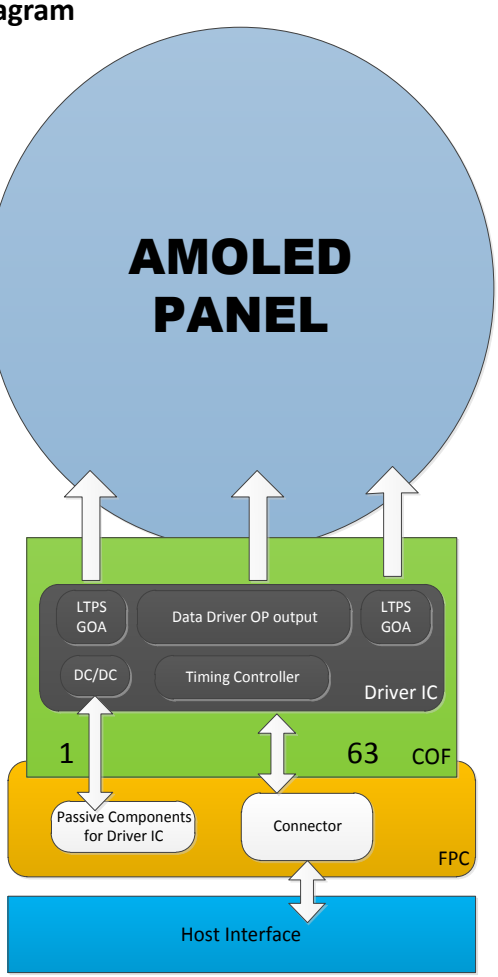
Pin No.	Symbol	I/O	Function Description
1	SDA_TP	I/0	TP IIC signal
2	SCL_TP	I/0	TP IIC signal
3	INT_TP	I/0	TP IIC signal
4	SWIRE	I/0	OLED ELVDD,ELVSS enable signal
5	RESET	I/0	OLED RESET signal
6	IMO	I/0	interface switch signal
7	IM1	I/0	interface switch signal
8	DB0	I/0	QSPI signal
9	DB1	I/0	QSPI signal
10	SDI	I/0	QSPI signal
11	DCX	I/0	QSPI signal
12	CSX	I/0	QSPI signal
13	SCL	I/0	QSPI signal
14	VCC	Power	Driver IC analog supply
15	GND	Power	GND
16	GND	Power	GND
17	TE	O	Tear effect output
18	IOVCC	I	Driver IC digital I/O supply
19	GND	Power	GND
20	DSI_CLKN	I/0	MIPI DSI clock-
21	DSI_CLKP	I/0	MIPI DSI clock+
22	GND	Power	GND

23	**DSI_D0N**	I/O	MIPI DSI data0-
24	**DSI_DOP**	I/O	MIPI DSI data0+
25	**GND**	I	GND
26	**MTP**	I	Power supply for OTP. Leave the pin open when not in use.
27	**SWDIO**	O	TP OTP PIN
28	**VDD 3.3V_TP**	Power	TP analog Power Supply
29	**RST_TP**	I	Reset pin for TP IC
30	**GND_TP**	Power	GND
31	**ELVSS**	Power	Power supply for OLED
32	**ELVSS**	Power	Power supply for OLED
33	**ELVDD**	Power	Power supply for OLED
34	**ELVDD**	Power	Power supply for OLED

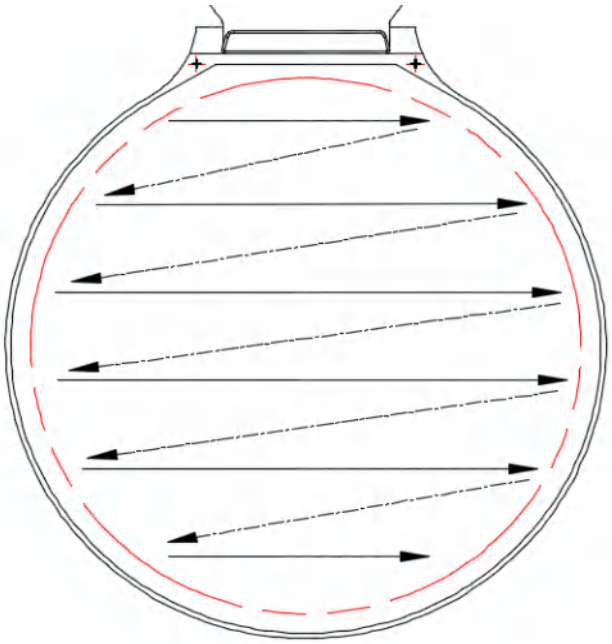
1.1 Initial CODE

TBD

5.4.3 System Block Diagram

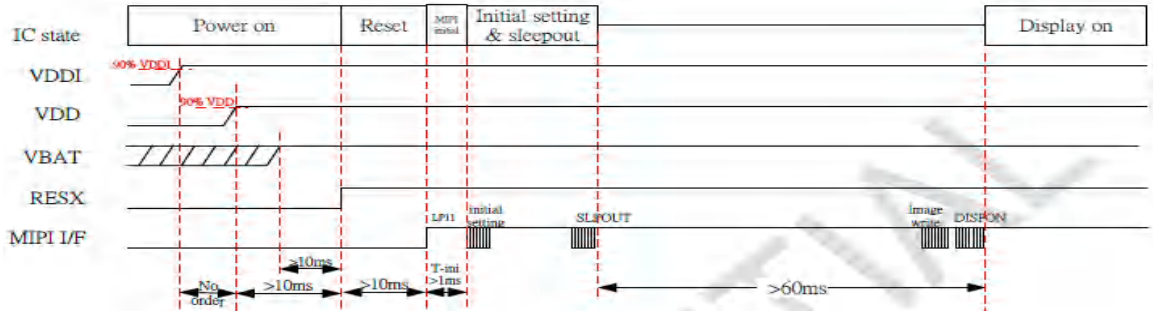


1.2 Graphic memory writing direction

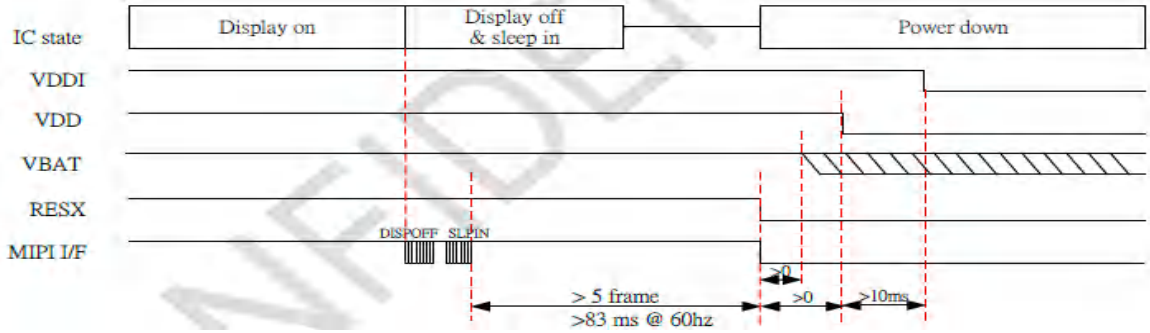


1.3 Recommended Operating Sequence

5.5.1 Power on sequence

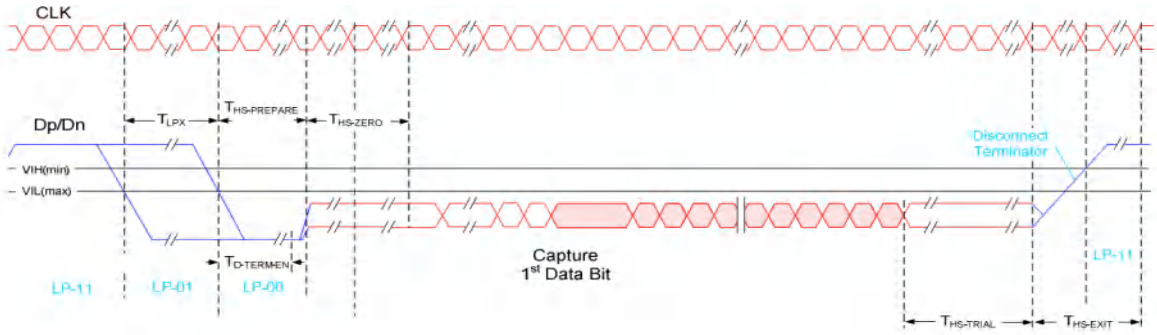


5.5.2 Power off sequence

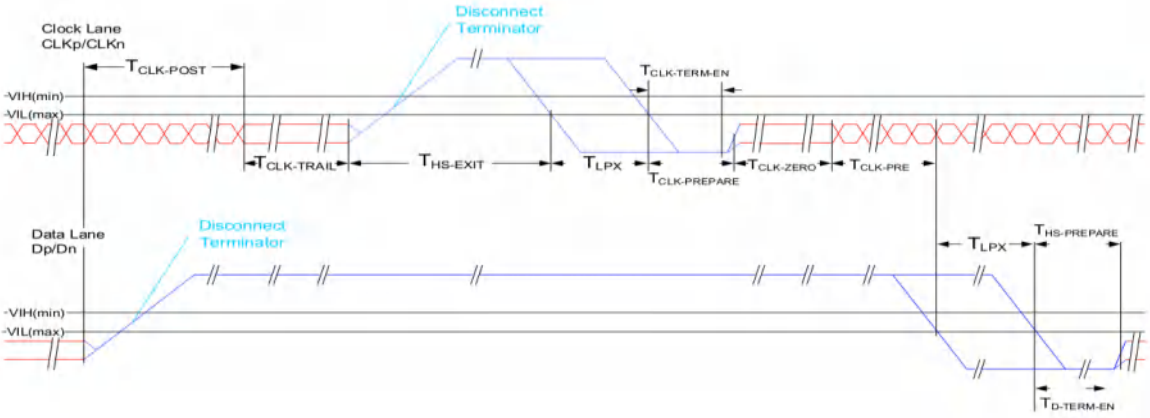


1.4 AC Characteristics（MIPI）

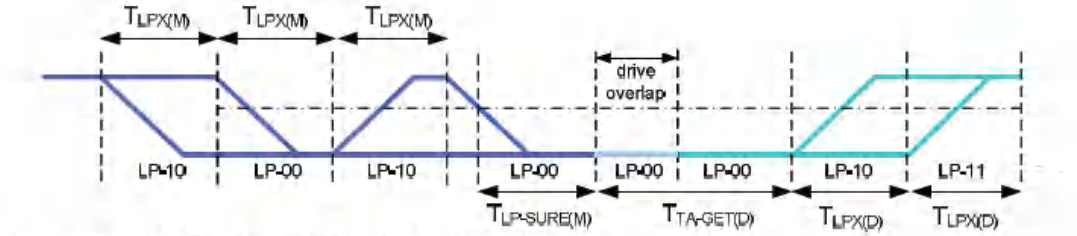
5.6.1 HS Data Transmission Burst



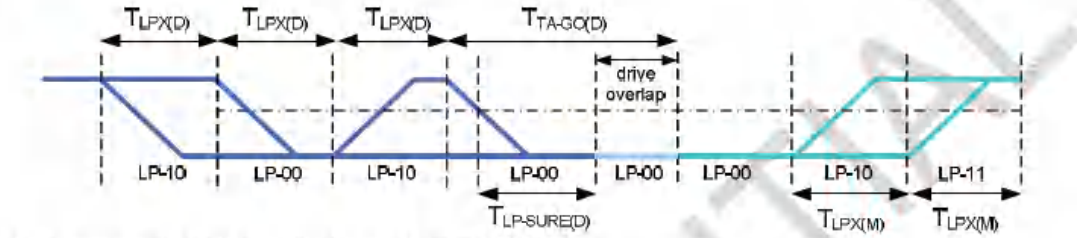
5.6.2 HS Clock Transmission



5.6.3 Turnaround Procedure



Bus turnaround (BAT) from MPU to display module timing



Bus turnaround (BAT) from display module to MPU timing

5.6.4 Timing Parameters

Symbol	Description	Min	Typ	Max	Unit
TREOT	30%-85% rise time and fall time	-	-	35	ns
TCLK-MISS	Timeout for receiver to detect absence of Clock transitions and disable the Clock Lane HS-RX.	-	-	60	ns
TCLK-POST*1	Time that the transmitter continues to send HS clock after the last associated Data Lane has transitioned to LP Mode. Interval is defined as the period from the end of THS-TRAIL to the beginning of TCLK-TRAIL.	60ns + 52*UI (For DCS)	-	-	ns
TCLK-PRE	Time that the HS clock shall be driven by the transmitter prior to any associated Data Lane beginning the transition from LP to HS mode.	8	-	-	ns

TCLK-SETTLE	Time interval during which the HS receiver shall ignore any Clock Lane HS transitions, starting from the beginning of TCLK-PRE.	95	-	300	ns
TCLK-TERM-EN	Time for the Clock Lane receiver to enable the HS line termination,starting from the time point when Dn crosses VIL,MAX.	Time for Dn to reach VTERM-EN		38	ns
THS-SETTLE	Time interval during which the HS receiver shall ignore any Data Lane HS transitions, starting from the beginning of THSPREPARE.	85 ns + 6*UI		145 ns + 10*UI	ns
TEOT	Time from start of THS-TRAIL or TCLK-TRAIL period to start of LP-11 state	-	-	105ns+48*UI	ns
THS-EXIT(1)	time to drive LP-11 after HS burst	100	-	-	ns
THS-PREPARE	Time to drive LP-00 to prepare for HS transmission	40ns + 4*UI	-	85ns+6*UI	ns
THS-PREPARE + THS-ZERO	THS-PREPARE + Time to drive HS-0 before the Sync sequence	145ns + 10*UI	-	-	ns
THS-SKIP	Time-out at RX to ignore transition period of EoT	40	-	55ns+4*UI	ns
THS-TRAIL	Time to drive flipped differential state after last payload data bit of a HS transmission burst	60 + 4*UI	-	-	ns
TLPX	Length of any Low-Power state period	50	-	-	ns

Ratio TLPX	Ratio of TLPX(MASTER)/TLPS(SLAVE) between Master and Slave side	2/3	-	3/2	ns
TTA-GET	Time to drive LP-00 by new TX	5*TLPX	5*TLPX	5*TLPX	ns
TTA-GO	Time to drive LP-00 after Turnaround Request	4*TLPX	4*TLPX	4*TLPX	ns
TTA-SURE	Time-out before new TX side starts driving	TLPX	-	2*TLPX	ns

5.6.5 Timing requirements for RESETB

When RESETB of the reset pin equals to Low, it will be in the condition of reset.

When it is in the condition of reset, it will make the device recover the initial set.

However, in order to avoid the reset noise cause reset, there is a mechanism to judge about whether the reset is needed or not.

The closed interval of Low can be shown as the following.

(Test condition: VDDIO=1.65V~3.6V, VSS=0V, T_A=-20℃~+70℃)

Parameter	Symbol	Conditions	Spec			Unit
			Min.	Typ.	Max.	
Reset low pulse width	Trst	-	20	-	-	μs

Table: Reset timing

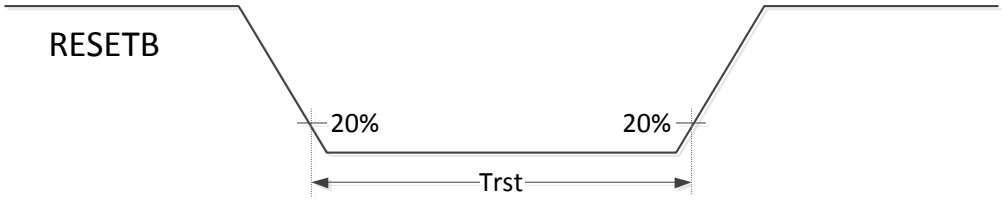


Figure: Reset timing

2 Electro-Optical Specification

Test condition： IOVCC=1.8V , VCI=2.8V ,Ta=25℃

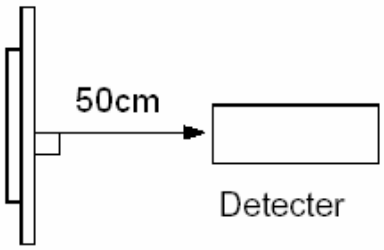
Item		Symbol	Condition	Value			Unit	Note
				Min	Typ	Max		
Luminance			θ=0°	315	350	385	cd/m2	Note 1
Uniformity			Φ=0°	85		-	%	Note 2
Viewing Angle	Left	θ_L	Cr≥200	80	85	-	Deg.	Note 3
	Right	θ_R		80	85	-		
	Top	ψ_T		80	85	-		
	Bottom	ψ_B		80	85	-		
Contrast Ratio		CR	θ=0°	5000	10000	-	-	Note 4

Response Time		Tr+Tf	Φ=0°	-	2	3	ms	Note 5
Color Coordinate of CIE1931	Red	X	θ=0° Φ=0°	0.656	0.686	0.716	-	-
		Y		0.283	0.313	0.343		
	Green	X		0.195	0.235	0.275		
		Y		0.685	0.725	0.765		
	Blue	X		0.113	0.143	0.173		
		Y		0.014	0.044	0.074		
	White	X		0.28	0.30	0.32		
		Y		0.29	0.31	0.33		
NTSC Ratio		NTSC	DCI-P3		100	-	%	-
Flicker		-	-	-	-	-30	dB	-
Gamma		-	-	2.0	2.2	2.4		Note 6
Crosstalk		ΔCT	-	-	-	1.1		Note 7

Note 1: Luminance measurement

The test condition is measured on the surface of AMOLED module at 25℃.

- Measurement equipment CS2000 or similar equipment (Field of view:1deg,Distance:50cm)
- Measuring surroundings: Dark room.
- Measuring temperature: Ta=25℃.
- Adjust operating voltage to get optimum contrast at the center of the display.



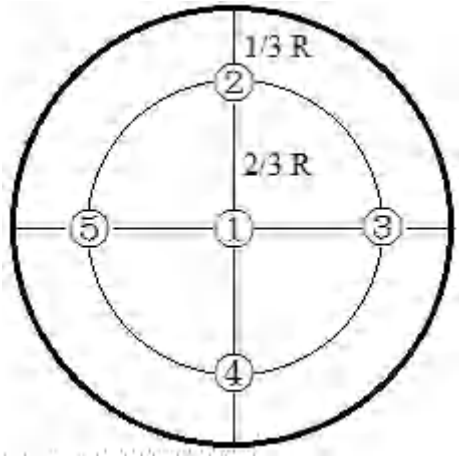
Note 2: Uniformity

The luminance uniformity is calculated by using following formula:

ΔBp = Bp (Min.) / Bp (Max.)×100 (%)

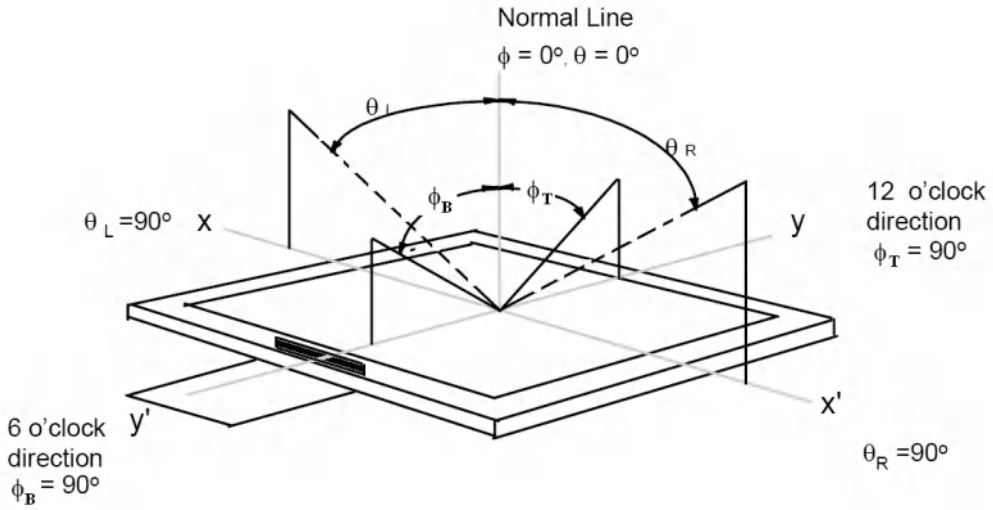
Bp (Max.) = Maximum brightness in 5 measured spots

Bp (Min.) = Minimum brightness in 5 measured spots.



Note 3: **The definition of Viewing Angle**

Refer to the graph below marked by ϑ and Φ

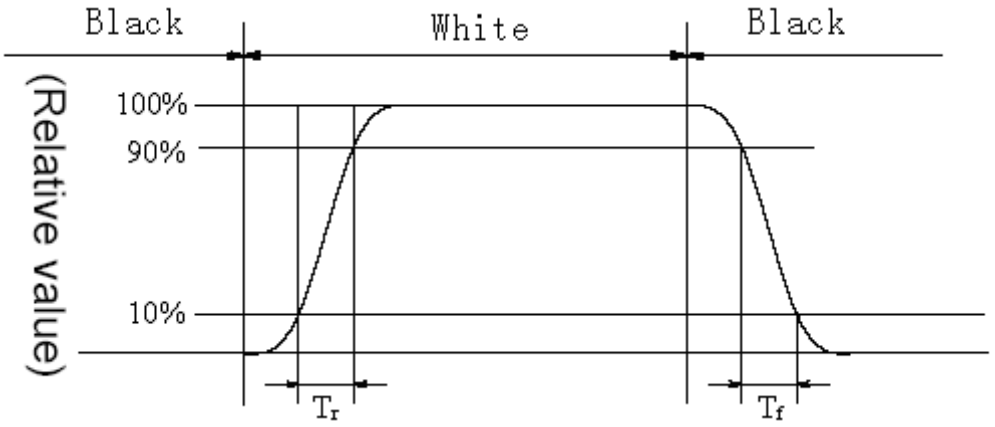


Note 4: **The definition of Contrast Ratio**:

$$\text{Contrast Ratio (CR)} = \frac{\text{Luminance When AMOLED is at “White” state}}{\text{Luminance When AMOLED is at “Black” state}}$$

Note 5: **Definition of Response time.**

The output signals of photo detector are measured when the input signals are changed from “black” to “white” (Voltage falling time) and from “white” to “black” (Voltage rising time), respectively. The response time is defined as the time interval between the 10% and 90% of amplitudes. Refer to figure as below.



Note 6: Gamma curve

The whole curve's tolerance must control within +/-0.3, test the gray scale below:
8, 16, 25, 33, 41, 49, 58, 66, 74, 82, 90, 99, 107, 115, 123, 132, 140, 148, 156, 165, 173, 181, 189, 197,206, 214, 222, 230, 239, 255

Note 7: **Crosstalk**

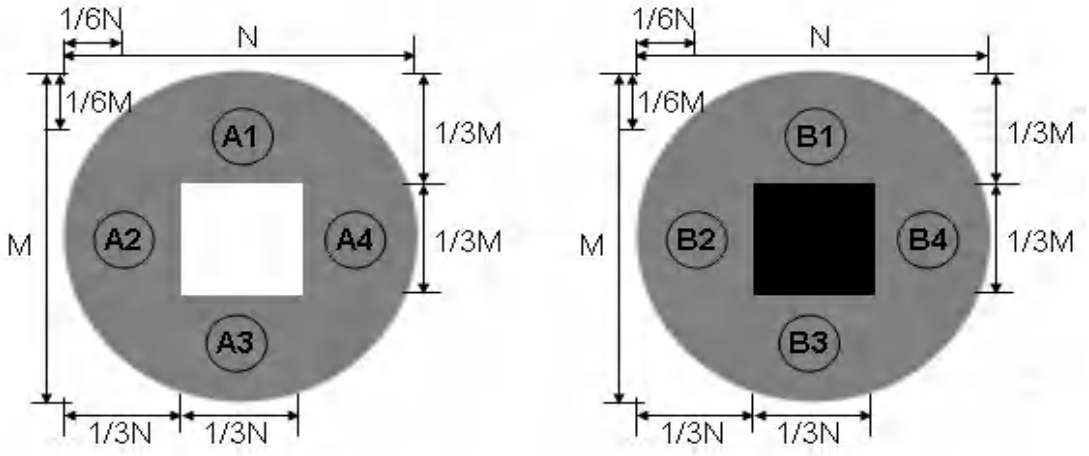
There should be no visible cross-talk in normal direction of the display when the two "Cross-talk Test Patterns" below are loaded.

ΔBp (Max.) = Maximum value in ΔBp1~ΔBp4.

ΔBp (Min.) = Minimum value in ΔBp1~ΔBp4.

ΔCT=ΔBp (Max.)/ ΔBp(Min.).

ΔCT must be less than 1.10



Cross-talk Test Pattern

3 Reliability

3.1 Environmental Test

Item	Main spec	No. of failures / No. of examinations
High Temperature Operation	70℃/ 240hours	0/ 5
Low Temperature Operation	-20℃/ 240hours	0/ 5
High Temperature Storage	80℃/ 240hours	0/ 5
Low Temperature Storage	-30℃/ 240hours	0/ 5
High Temperature Humidity Operation	60℃/ 90%RH 240hours	0/ 5
Thermal Shock	-40℃~80℃ 0.5hr, 50 cycles	0/ 5

3.2 Electrical Test

Item(Display)	Main spec	Note
Air Discharge	±4kV , 150pF/330Ω （Module level）	5Points, Each 2times. No degradation of OLED performance after this test.
Contact Discharge	±4kV, 150pF/330Ω （Module level）	

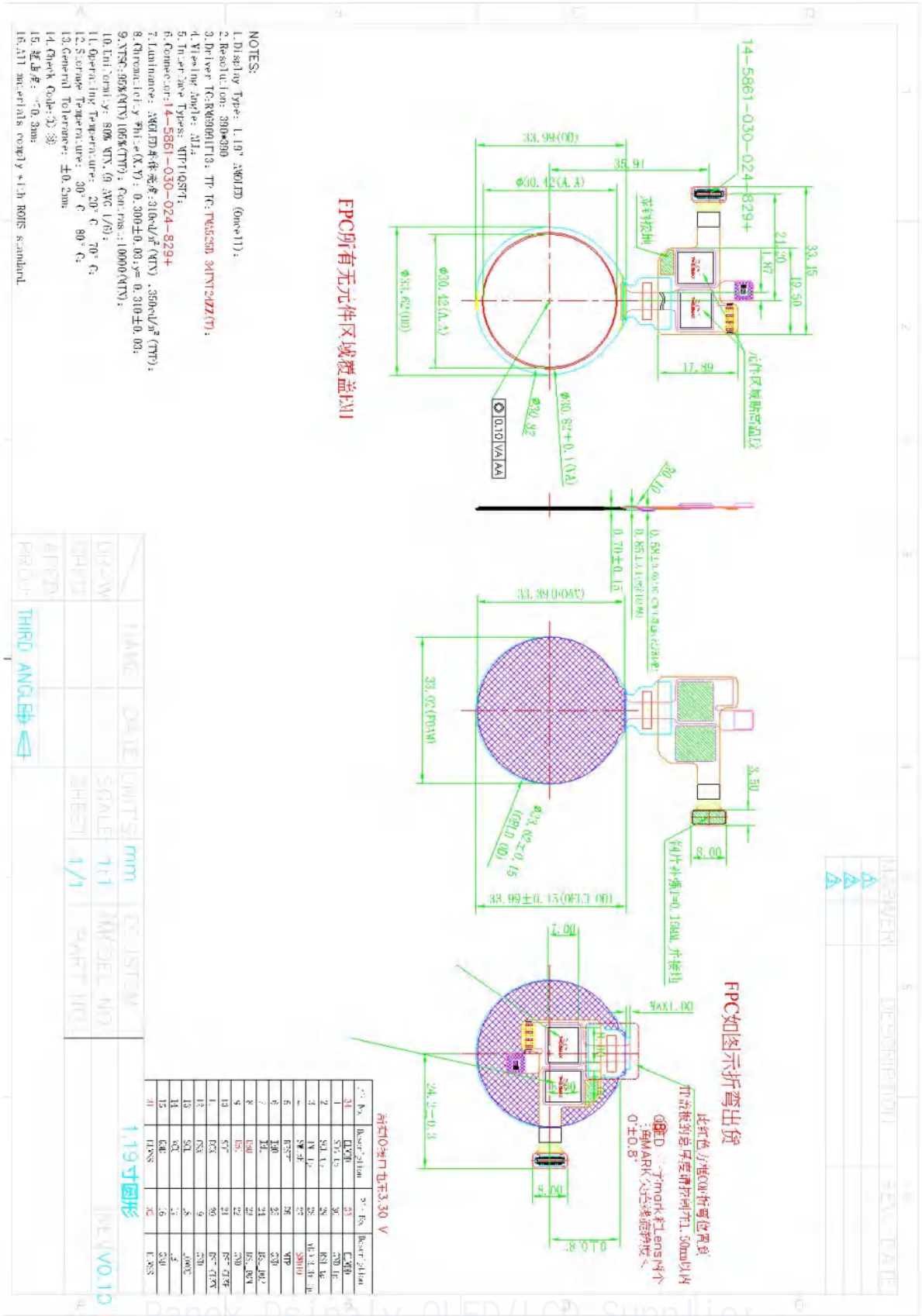
3.3 Mechanical Test

Item	Main spec	Note
Drop Test	Drop the packing from 75cm height, 3 times for 6-faces, 3-edges and 1-corner	Package
Vibration-proof test	2g, f=10->55->10Hz apply in each of X, Y, and Z direction for 30 min	Package

4 Handling Precautions

1. When cleaning ITO pad, avoid using hard and abrasive material or corrosive solution
2. Keep module away from direct sunlight or fluorescent light, and keep it at room temperature and humidity
3. Strong impact & pressure on module and packing is prohibited
4. Following normal power on/off sequence is necessary for preventing abnormal display or permanent damage to display
5. Optimal contrast ratio under ideal voltage is AMOLED module's characteristic, hence it is recommended a voltage control function available
6. Image sticking may occur if an image displays for an extended period of time
7. When interfered by system's overall mechanical design, an abnormal display may occur
8. After considering emitting energy, you should plan your design to satisfy EMI standards.
9. Host side should place a surge-prevent circuit at power trace (ie: VCI, Vddi) to protect AMOLED module.

5 Outline Dimension Drawing



10 The Control of Hazardous substances

The Control of Hazardous substances refer to EDO document《有害物质管控标准书》(Standard document for the Control of Hazardous substances) EDO-IS-110, the latest version.